PG&E Facilities Risk Management







- Terry White PG&E
 - Director, Facility Integrity Management & Technical Services
 - Asset Family Owner, Measurement & Control (M&C) & Compression & Processing (C&P)
- Troy Rovella PG&E
 - Manager, Station Assessments





- Overview of PG&E
- 2. Pipeline vs. Station Differences
- 3. How We Identify, Evaluate and Manage Risk
 - At the Fleet Level
 - At the Station Level
 - At the Component Level
- 4. Opportunities



Pacific Gas & Electric Company

Asset

Management

One of the Largest Combined Gas & Electric Utilities in the United States

- ~ 20,000 Employees
- ~ 70,000 Square Mile Service Territory
- ~ 4.3 Million Gas Customer Accounts
- ~ 42,000 Miles of Distribution Pipe
- ~ 6,700 Miles of Transmission Pipe
- 3 Storage Facilities (25% Ownership in a Fourth)
- 9 Compressor Stations
 - ~ 212,000 Horsepower
- ~ 450 Transmission Regulation / Metering Stations
- 3 Terminals
- PAS 55, ISO 55001, API 1173, RC 14001 Certified







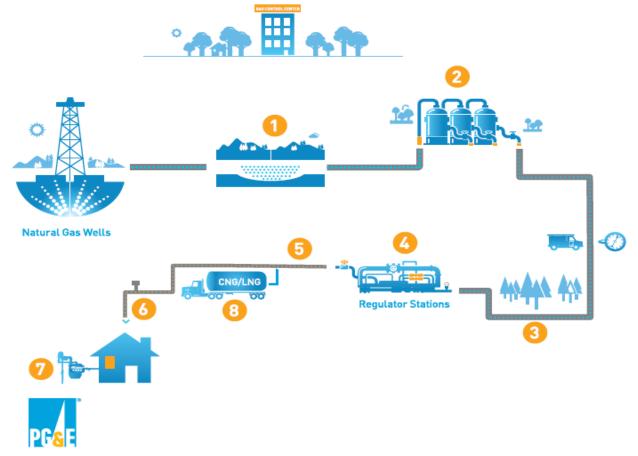


We will be the safest, most reliable gas company in the United States

Asset Families

- 1 Gas Storage
- Compression & Processing
- 3 Transmission Pipe
- 4 Measurement & Control
- 6 Distribution Mains
- 6 Distribution Services
- Customer-connected Equipment
- 8 Compressed Natural Gas/ Liquefied Natural Gas

Natural Gas System Overview Asset Families





Measurement & Control Asset Family





District Regulator Station (~2,400)

Additional Assets

- Terminals (3 Facilities)
- Distribution Farm Taps (~2400)



Compression & Processing Asset Family







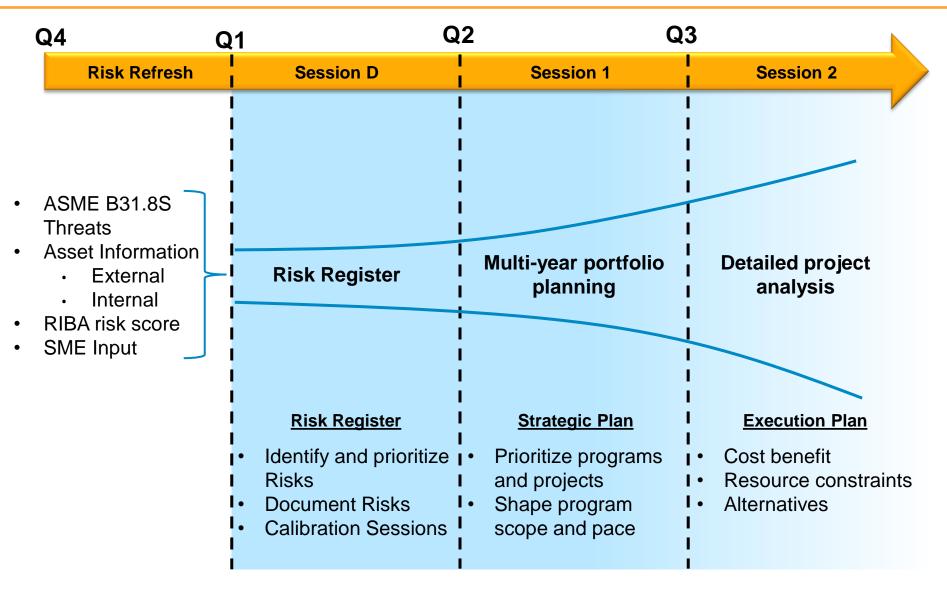
Pipeline vs. Station Differences

Stations are different than pipe and, therefore, require a different approach

- ✓ Pipeline focus is on integrity risks
- ✓ Station focus must address reliability and integrity risks
- ✓ Station design factor provides higher safety margin
- ✓ In aggregate, facilities have a significantly smaller footprint
 - Geographical overlay of the Potential Impact Radius (PIR) for PG&E's stations is ~1% of its pipeline assets
 - Total pipe length of PG&E's station piping is ~1% of its transmission pipe
 - ~60% of PG&E's station features are accessible for inspection and maintenance as opposed to pipeline that is underground



Enterprise Integrated Planning Process





Identifying, Evaluating and Managing Risk: Fleet Level

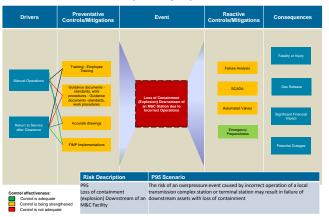


How We Identify, Evaluate and Manage Risk Fleet Level

Primary Causes of Failures Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Primary Prevention Measures (highest impact on risk reduction. From left to right) Province County Province P

Threat Matrix

Bow-Ties (Example)



Fleet level risk management tools

- Risk Register: Identify, evaluate and prioritize risk
- Threat Matrices: Identify fleet level mitigation programs
- Additional assessment of risks and mitigations
 - Fault trees
 - Bow-ties
- Asset management
 - Asset Management Plans
 - Long-term compression investment plan



How We Identify Risk Fleet Level

	Time	e-Dependent Thr	eats		Stable Threats		Time	e Independent Th	reats
	"The threat I	evel may grow over time if	unchecked"	"The threat is inheren	t but does not grow over til pressure or external load	' '	"The threat	exists outside of the continu	uum of time"
	External Corrosion	Internal Corrosion	Stress Corrosion Cracking	Manufacturing Related Defects	Welding / Fabrication Related	Equipment	Third Party / Mechanical Damage	Incorrect Operations	Weather Related & Outside Forces
Primary CAUSES	1) Transitions 2) Inadequate coating 3) Atmospheric conditions	1) Liquids 2) Sulfur 3) Erosion	Not a high risk for asset family	1) Poor quality manufacture 2) Inadequate specifications 3) Strength test documentation	1) Poor construction practices 2) Inadequate QC/inspection	1) Age, Obsolescence 2) Incorrect sizing/design 3) Maintenance related 4) Sulfur 5) Liquids entering the system 6) Vault flooding (LP)	1) Vandalism 2) Excavation Damage 3) Vehicular Damage 4) Cyber Threat	1) Inadequate procedures 2) Human error 3) Quality of station documentation 4) Inadequate training 5) Debris from pigging & hydrotesting	1) Flooding 2) Seismic events

PG&E data sources

- Event data (Corrective Action Program)
- Maintenance information
- Condition assessments
- Equipment obsolescence information
- Outage data
- Root cause analyses
- Records reviews
- Subject matter expert perspectives

Industry data sources

- PHMSA information
- INGAA / AGA information
- Benchmarks
- Third party reviews and assessments



How We Evaluate Risk Fleet Level

Risk Register

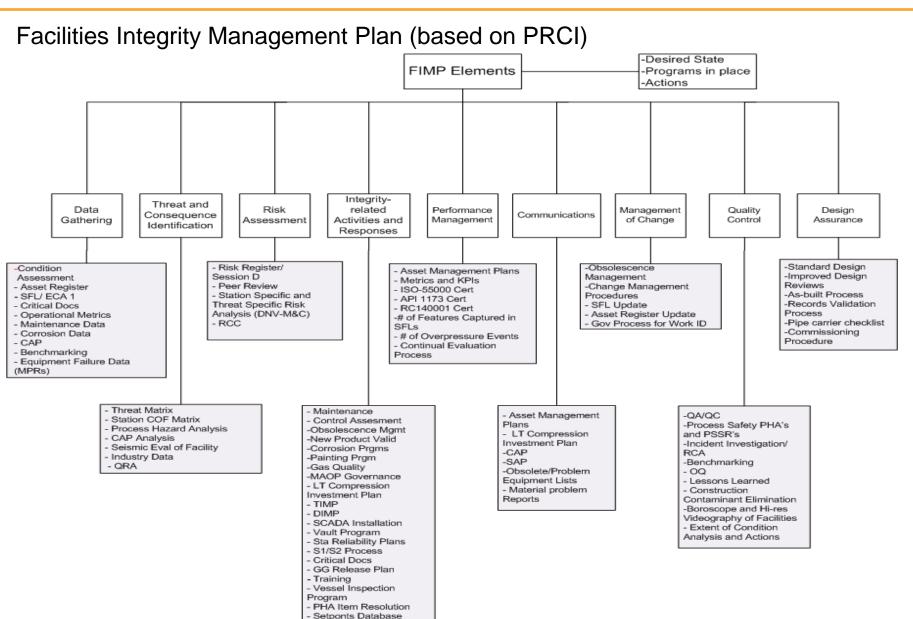
V2.0 D20140221

Frequency Description	Frequency per Year	Frequency Level
> 10 times per year	F = >10	Common (7)
1 - 10 times	F=	
peryear	1-10	Regular (6)
Once every 1-3 years	F= 1-0.3	Frequent (5)
Once every 3 - 10 years	F= 0.3 - 0.1	Occasional (4)
Once every 10 - 30 years	F = 0.1 - 0.033	Infrequent (3)
Once every 30 - 100 years	F= 0.033 - 0.01	Rare (2)
Once every 100 + years	F= <0.01	Remote (1)

			Safe S Reliable	Service		
			Affordabl	ie Service		
Impact Level	Safety	Environmental	Compliance	Reliability	Reputational	Financial
astrophic (7)	Fatalities: Many fatalities and life threatening injuries to the public or employees.	Duaditor: Premarent or long-term damage greater than 100 years; or Natural tree/Toxidity: Release of toxic material with immediate, actual and inversible impacts to surrounding environment; or Outsides: Event causes destruction of a place of international cultural significance; or Size: Event results in extinction of a species.	 Adverse Regulatory Actions: Action resulting in closure, split, or sale of the Company. 	Leadine: Impacts an entire entropolitian area, including critical customen, or in system-wide. or system-wide. Duration: Disruption of service of more than a year due to a perameter loss to a nuclear facility, hydro facility, critical gas or electric assist. In control of the contr	 Duratise Ongoing impacts for more than 30 years, and Media: Event is heavily reported from local strough international media outlets and social media channels, with influential third parties dominating media overage; various inaccurate information is widely reported. Politica: Devastating nationwide broad-based political pressure demanding interes long term outreast to politywaters and key stateholders; or Conteners 25th lettics or Gener than 326 loss of customer 25th lettics or care than 326 loss of customer Company Mand: Selvisionalitys are severed and trust is completely out. 	 Financial Costs: Dimage to third party properties, loss assets and folialities, fines, lawouts, restitution, remediate assets and folialities, fines, lawouts, restitution, remediate outsomer costs, amounting to a total impact \$5 sbillion costs; or Capital / Uquidity: Ability to naise capital significantly impacted. Dimantic decrease in stock price of more than of rome than of rom
Severe (6)	Fatalities: Few fatalities and life threatening injuries to the public or employees.	Distriction: Long-term damage between 11 years and 100 years; or Natard twel/Toxidity, Release of toxic material with scale and long-term impacts to surrounding environment, or Location: Event causes destruction of a piace of national cultural significant; or Constitution of the Consti	Adverse Regulatory Actions: Case and desix orders are delivered by regulators. Critical assets and facilities are forced by regulators to be shutdown.	§§. 400% miss of equivalent forced outage factor and/or availability target. Leadine impacts multiple critical locations and critical customers or or burstine substantial disruption of service greater than 100 days; or o Duration substantial disruption of service greater than 100 days; or o Customer impacts: Unplanned outage (net of replacement) impacts more than 100k outsomers; or of customers than 100k mush total locat; until customers thours, or more than 100k mush total locat; until on total customer hours, or loss of service greater than 500k themps.	Duration: Origining impacts between 1 and 10 years; and Media: Event is heavily reported from local through national media outlets and social media chamely, with influential third parties dominating media coverage, and various inaccurate information is widely reported; or or Portice. Extreme statewise toward based political products or Portice. Extreme statewise for social designation and ley stakeholders; or Court of the Court o	o Financial Costs. Camage to third party properties, burs savets and facilities, fines, barroids, vestinution, emerdial restoration, cost of reglacement energy, redistributed customer costs, amounting to a total impact between 550 million and 55 billion in costs; or Capital / Liquidity-Ability to raise capital is challenged. Domantic occrease in stock price of more than 25% for m than one year.
Extensive (5)	Permanent/Serious Injuries or Illnesses: Many serious injuries or Illnesses to the public or employees.	 Naund tewel/Toxicity: Release of toxic material with a significant threat to the environment and/or release with medium-term reversible impact; or Location: Event cause electruction of a place of regional cultural significance; or Sear Event results in harm to multiple individuals of a protected species. 	o Adverse Regulatory Actions: Governmental, regulatory investigations, and enforcement actions, lasting longer than a year. Violations that result in fines or penalties commensurate with the Financial State free and regulators enforce multiple large non financial sanctions; or increased Regulatory Oversight Regulators force the removal and replacement of management positions. Regulators begin Company monitoring activities.	§5. 200% miss of equivalent forced outage factor and/or availability target. a location: Impacts multiple critical locations or customers, or a Duration: Dramption of service greater than 10 days, or Customer Impacts Uniquined outage (not of episcement) impacts more than 30 customers, or CD 500 ktotal costomer hours, or more than 10k mwh total load; CD 500 ktotal customer hours, or loss of service greater than 50 ktotal customer hours.	 Company Mand: Event creates outrage and trust can't be fully recovered Duration: Organize impacts between 3 quarter and 1 year or Medica: Event solder in protein and endea outlets and social media others and social media doutlets and social media othersels, with influential thiring parties dominating media coverage, and inaccurate information is reported; or Political: Severe territory wide political pressure demandring extensive outreach to policymakers and key stakeholders; or Customer Stäfsteindor: 48: "20% is sof outstomer satisfaction through survey results; or Company Yamack Gener creates serious concerns of company management while trust is severely diminished 	o Financial Costs: Damage to third party properties, loss sacets and facilities, fines, Lawroist, restitution, remediacino, cost of replacement energy, redistributed castomer costs, anounting to a total impact between SS9 million and SS00 million in costs, or capital / Jungleich between SS9 million and SS00 million in costs, or Capital / Jungleich Ablity to roise capital is hindered. Dramatic decrease in stock price of more than 10% for up one year.
Major (4)	 Permanent/Serious Injuries or Illnesses: Few serious injuries or Illnesses to the public or employees. 	 Deathers-Short-term damage of up to 2 years, or - Nazad-tevel/Tookin-Release of material with a significant throat tevel relative Release of material with a significant throat the mission of a release with short-term reversible impact, or reversible impact, or reversible impact, or site or site	 Advens Regulatory Actions: Violations that result in fines or penalties commensure with the financial Risk citeria, or a regulator enforces non financial sanctions; or Capander Regulations: Significant new and updated regulations are enacted as a result of an event. 	Location: Impacts a single critical location; or Doutsides: Disapsion of service greater that day, or Customer Impact: Unplanned outage (net of replacement) impacts more than it accisament, or Location of the control outage (net of replacement) Location outage factor and/or availability target	Duration Chigoling impacts between I week and I quarter, or Media: Event is heavily reported in local through national media outlets and social media channels, with influential thirting parties dominating media outween, and inaccurate of the properties of the properties of the properties of the properties of Political Major territory wide political pressure demanding major outweets to politica	 Financial Costs: Damage to birdi party properties, loss sasets and facilities, fines, lawsurfs, settlution, remedi restoration, cost of replacement energy, redistributed customer costs, amounting to a total impact between 52 million and 550 million in costs.
Moderate (3)	 Minor injuries or illnesses: Minor injuries or illnesses to many public members or employees. 	Duration: Short-term damage of a few months; or Natural Level/Toxicity; Release of material with a moderate theret to the environment and/or release with short-term theret to the environment and/or release with short-term of Location: Event causes damage to an individual cultural site; or Size: Event results in damage to the known habitat of a protected species.	Adverse Regulatory Actions: Violations that result in fines or penalties commensurate with the Financial Risk orderia.	Location: Impacts a small area with no disruption of service to critical locations; or Douatants: Charpopt on deriviced usy to 1 fail day, or O bustation: Charpopt on deriviced usy to 1 fail day, or O bustation of the subsequent or of the subsequent of the su	Duration: Short term coverage for up to 1 week. Media: Event is reported in multiple local media outlets and/or social media drametal; with instelled exposure beyond and/or social media drametal; with instelled exposure beyond or Political bodierate country level political pressure demanding moderate outleach to politivanisher and key stakeholders; or Customer Satisfaction: Less than 1% loss of outstomer or satisfaction country and satisfaction control survey results; or Company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted; or company Brand: Event inn't anticipated and trust is impacted.	 Financial Costs: Damage to third purty properties, loss assets and facilities, fines, lawsuits, restitution, remedie restoration, cost of reglacement energy feditionated and strength of the rest of the strength of the strength of the strength of the strength of the and 55 million in costs.
Minor (2)	Minor lightles or illnesses Minor injuries or illnesses to few public members or employees.	Destine: immediately correctable; or contained within a small area.	 Adverse Regulatory Actions: Self-reported or regulator identified violations with no fines or penalties. 	Leadines impacts a small bookined are with no disruption of service to critical locations; or Duration Disruption of up to a hours; or O burstion: Disruption of up to a hours; or Customer impact; bugshared outage (rest of replacement) impacts less than 20 customers; or O test than \$4 total customer hours, or less than 100 mwh total load; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service less than \$500 heres; O test than \$4 total customer hours, or loss of service O test than \$4 total customer hours, or loss of service O test than \$4 total customer hours, or loss of service O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss of O test than \$4 total customer hours, or loss	Durations single report of the event. Media: Event is appropried in a single local media outlet in the location where the event took place; or Political Minning political pressure demanding minimal outreach to policymaken and key stakeholden; or	 Financial Coets: Diamage to Interplay properties, loss assets and facilities, fines, lawsurks, refettion, remediation, restoration, cost of replacement energy, redistributed existence costs, amounting to a total impact between 5th and 5500k in costs.
legligible (1)	No injury or illness or up to an un-reported negligible injury.	Negligible to no damage to the environment.	o No compliance impact up to an administrative impact.	No reliability to negligible impacts.	No known reputation impact reported to a non featured report.	 Financial Costs: Damage to third party properties, loss assets and facilities, fines, lawsuits, restitution, remedia restoration, cost of replacement energy, redistributed customer costs, amounting to a total impact of less than in costs.



How We Manage Risk Fleet Level



OMOD Process



Identifying, Evaluating and Managing Risk: Station Level



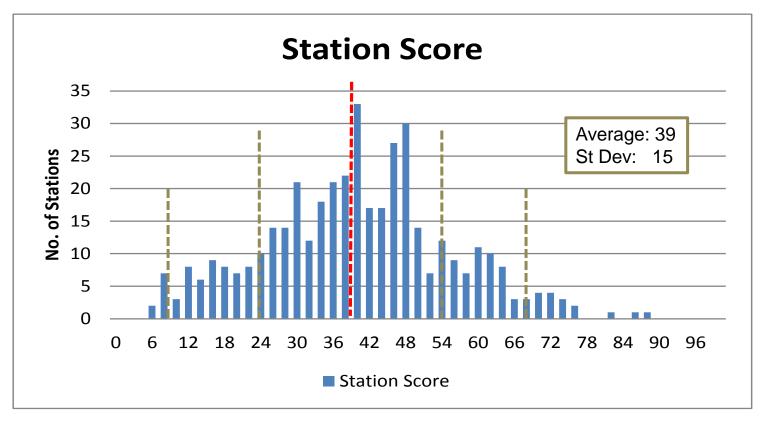
How We Identify, Evaluate and Manage Risk Station Level

- Activities currently addressing risk on a station basis
 - Condition assessment
 - Operational testing and repairs
 - Process Safety Management
 - Project prioritization
 - Additional programs

cility Name	Equipment	Equipment Description	Equipment Grade	Equipment Type	Equipment Class	Weighting Factor	Station Gra	de				
	V-7	VALVE - ACTUATED	4.85	MONITOR	1	100%	69.00					
	F-2	GAS FILTER / SEPARATOR	4.10	FILTER	2	50%	1					
	V-1	VALVE - MANUAL	3.94	VALVE		0%	1					
	V-10	VALVE - MANUAL	4.10	VALVE	3	0%	1					
	V-11	VALVE - ACTUATED	4.85	REGULATOR	1	100%	1					
	V-12	VALVE - ACTUATED	4.85	REGULATOR	1	100%	1					
	V-17.26	VALVE - MANUAL	4.10	VALVE	3	0%	1					
	V-2	VALVE - MANUAL	4.10			AN	1					
	V-27.74	VALVE - MANUAL	3.94	Equipment No.		scription (Manuf	acturer	Metric Definition	Metric Score	Weighting	Equipment Grade	Manufacturer / Model
4	V-3	VALVE - MANUAL	4.10			/ Model)				Factor		Equipment Photo
8 8	V-4	VALVE - MANUAL	4.70	V-11	VALVE - ACTUA	ATED (0 0)						
0	V-5	VALVE - MANUAL	4.70		Age			of equipment from installation and	10	10%	4.85	
2	F-1	GAS FILTER / SEPARATOR	4.10				base	d on % of expected equipment life.		1		
19	V-65.70	VALVE - MANUAL	3.94									
ARKINS RD REGULATOR STA	RTU	REMOTE TERMINAL UNIT	3.10					afacturer and model; current	10	15%		
R	V-8	VALVE - MANUAL	4.10		Equipment)			s of equipment item in industry				
Ž	V-9	VALVE - MANUAL	4.70				(Still	made, spare parts available, etc.)				
S.	V-C	VALVE - MANUAL	4.54		Manufactures	/ \$4ndal /Drobless	Man	sfacturer and model; equipment	1	15%	-	
ī	V-D	VALVE - MANUAL	4.54		Equipment) id			ified as problem item by		13/6		4
	V-E	VALVE - MANUAL	3.94	ST/				tenance		15% 25%		
	V-F	VALVE - MANUAL	4.10	ATOR				ition based on visual inspection	1			
	PIPE	PIPE - STATION	4.10					nor social in the inspection	5			1 MANUAL PROPERTY AND ADDRESS OF THE PARTY AND
	M-1	METER - ORIFICE	4.10	10.8	Querational Efficiency		ending, Condition based on operational					
	PT-1	TRANSMITTER - PRESSURE	3.10	2				performance or functional tests				
	PT-2	TRANSMITTER - PRESSURE	3.10					sure of operational efficiency	1	4%	1	
	PT-3	TRANSMITTER - PRESSURE	3.10	N S	Formaced maintenance strategy			measured by energy costs, labor, or				
	FT-1	TRANSMITTER - FLOW	3.10	¥			open	ation attention				
	V-6	VALVE - ACTUATED	4.85	ž	Engineered ma	intenance strate	y Previ	entive or condition based tasks	7	4%	1	
				_	35.0		assig	ned for equipment				
					Number of Corrective Maintenance % Preventive Maintenance Overdue % Preventive Maintenance Overdue			ber of corrective maintenance	1	4%	1	
	C+	ation Cooke Ch	+					on the equipment		8		
	516	ation Score Sh	eet					preventive or condition based tenance tasks overdue	10	4%		
					% (Corrective N Maintenance)	Maintenance / To		corrective maintenance work s to total maintenance work hours	1	4%		
				37	wantenance		1000	TO LOCAL HARMACHARICE WORK HOURS				
									Coi	mpo	nent Sc	ore Sheet



How We Identify and Evaluate Risk Station Level



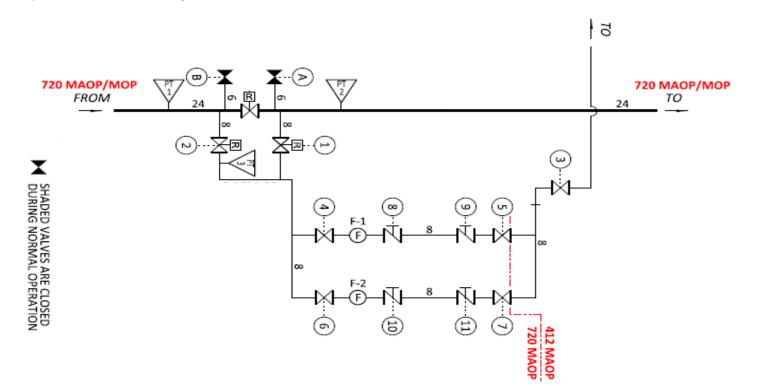
Components in Station	COF for H&S or Relia	ability of 5 or Greater	COF for H&S and Relia	ability of Less Than 5
Components in Station	Target Score	No. of Stations	Target Score	No. of Stations
Class 1 and 2 (Cat. X)	54.8	234	65.4	149
Class 1 Only (Cat. XA)	36.5	17	43.6	28
Class 2 Only (Cat. XB)	18.3	8	21.8	29

Station Target Scores Based on Consequence of Failure for Health & Safety and Reliability



How We Manage Risk Station Level – Next Steps

- Automated scoring of station condition assessment
- Risk calculated at the individual station level rather than the fleet level
 - Probability of failure based on equipment fragility data, asset condition, station configuration, location (seismic and liquefaction) and operational data
 - Consequence of failure based on occupancy counts and system connectivity
 - Updated annually





Identifying, Evaluating and Managing Risk: Component Level



How We Identify, Evaluate and Manage Risk Component Level

Facility Integrity Verification Process (IVP)

- Sequenced to follow the completion of the company's line pipe IVP
 - Prioritized in alignment with 'Pipeline vs. Station Differences' on slide 8
- Multiple programs filed as part of PG&E's 2015-2018 Gas Transmission and Storage Rate Case with the California Public Utility Commission

Engineering Critical Assessment – Phase 1 (ECA 1)

- Comprehensive evaluation of more than 80K distinct features to re-confirm MAOP and identify design related asset integrity issues
- Stations sequenced by relative risk ranking and operational constraints
- Involves the application of Sound Engineering Judgement
- Evaluation activities may include field investigations
- Non-conformances in design will be mitigated

176	Wester	(KCA-	quedite) S	ration III.		Stud	on Name				Lin		Long		Ste	tice (gen	тандоңб		Р (Харап	Number.		OP Die	gram Flore.		OP-Diago	um Sheet.		
Frade	e Comm	e partie		Pealson libr	er Brod ton	Postero	Basis	brid and			Com					Prof.	Granda				Mai /De	g Cides	001	001	VII	vs		
er G	ine®	Converting Saw ID	Françoi Burillori	Protes	Franços Tigas	Harve Jun CP* Chep Tept	AN Northern	holdCide	STREET	Pital ETPRI Summercial	Passaria Cumarenta	State State	Logia PC	Paser Clare Icoston	Historia Clare Josefon	Fallout.o Bridge Promise	About Security	Blend Angle	Gant Commission	Filinis and Assertage	DOM Namber	Havid Cod	PO	(Some	pej	(Steene Die)		
		П		ure ber		Fe	atu	re		Fe	atu	re 7	Гур	е	Jo	b N	lum	ber	lr	nsta	all C	ate		STI Num			OD1 (in)	WT1 (in)
			21			F	ipe	•		١	lo C	Cas	ing			95	617	76	0	5/1	2/1	993		2	2		16	0.656
			22	2	1	Mfg	Ве	end		Į	Jnk	nov	wn			195	617	76	0	5/1	2/1	993		2	2		16	0.656
			23	3		F	Pipe)		١	lo C	Cas	ing			195	617	76	0	5/1	2/1	993		2	2		16	0.656
			24	ļ		Re	duc	er		(Con	cS	Std			195	617	76	0	5/1	2/1	993		2	2		16	0.656
		Γ	25	;	Τ	7	Гее		Г	Re	duc	ing	Te	e –	-	95	617	76	0	5/1	2/1	993		2	2	Г	20	0.5

	Engineering Critical Analysis - Calculated Results														
	MAOP Computation and Selection														
	MAOP per Design (psig)	MAOP per Test (psig)	Limiting MAOP Value (psig)	%SMYS @ Limiting MAOP Value	Limiting MAOP Mode										
	1435	1333	1040	36.2%	R										
N A	1435	1333	1040	36.2%	R										
	1435	1333	1040	36.2%	R										
	1300	1333	1040	40.0%	R										
	1300	1333	1040	40.0%	R										



Field Investigation: Markings identify flanges as 1930's Vintage MWP 600 vs. MWP 720



How We Evaluate and Manage Risk Component Level

Engineering Critical Assessment – Phase 2 (ECA 2)

- Mitigation of discrepancies in strength test coverage identified during ECA 1 via low-risk and non-disruptive methodologies
- Under development in partnership with industry experts across multiple disciplines
- Places greater emphasis on probabilistic, rather than deterministic, modeling

Nondestructive Testing Tensile properties yield strength tensile strength Steel Chemistry C, Si, Mn, S, ... Lab Chemical Analysis Metallography and CVN Impact Testing Microstructure and Toughness

- Most probable grade
- Probabilistic material quality
- Remaining life



Evaluate benefits of NDE relative to hydrostatic strength testing





- Individual utilities have no or few occurrences of high consequence events limiting the ability to perform quantitative or probabilistic risk analysis.
 A universal set of industry level data is needed.
- Equipment failure rate data is not available to determine likelihood of failure. Determination of component or design risk is not precise.



Appendix



Threat Matrix (Representative)

complete:

partial

weak

How We Manage Risk Fleet Level

WHITE = Are not doing now

24

Primary Prevention Measures Primary Causes of Failures (highest impact on risk reduction - from left to right) Vandalism, terrorism Third Party Damage **Excavation Damage** Hand Digging Stand One Call Relocation of Physical Cyber-More Robust Time Independent Vehicular Damage MC30, MC30.1, **Inside Station** by System **Stations** Security security Designs · Cyber security MC30.2 **Threats** · Inadequate Procedures **Incorrect Operations** Human Error Guidance **Training** Enhanced **Improved** Design **Process** Post-Work **SCADA** MC3-MC6: MC8: Quality of Station Doc. **Documents** Site Docs **Process** Safety Training Inspections Visibility · Inadequate training MC11 Debris from pigging, hydro-test Station Low Flooding **Emergency** Weather & Outside Seismic Assessment for Seismic events Preparedness Elevation Design Standard Forces Supports, etc. **Assessment** Stations Lightning **Process** Designs **Procedures** MC32 Subsidence Reliability · Inadequate Capacity **Asset Management** Failure to Meet Clearance Processes Outage Failure to properly Plan (FIMP) Management Tool and Tools **Customer Demand** coordinate clearances Inadequate/Incorrect EOC Emergency response Emergency Gas Response Site Specific · Inadequate/Incorrect first Management **Transmission Business Emergency** GERP-Major Emergency or responder response **Control Center** Continuity **Plans** Advancement Response Based · Inadequate/Incorrect gas Program (EMAP) Plans Disaster **Plans Exercises** control response (GERP) · Inadequate/Incorrect dispatch response · Inadequate/Incorrect training GREEN = Meets or exceeds industry best practices RED = Does not meet industry best practices availability and the quality AND controls are adequate AND current controls are not adequate of the asset data

AMBER = Partially meets industry best practices OR

controls are being strengthened



Bow-Ties (Example)

How We Manage Risk Fleet Level

